

Technology Corner



Number 95-3

UDOT Research News

November 30, 1995

STRATEGIES TO REDUCE RECURRING INTERSTATE CONGESTION

Study Background and Scope

This research study was conducted by Dr. Glen Thurgood of the Civil and Environmental Engineering Department of Brigham Young University. The study focused on freeway congestion along the Wasatch Front from Provo on the south to Ogden on the north. The objectives were to develop and test a Freeway Congestion Index (FCI) that could be used to answer the following questions: Where does congestion occur? When does it occur? How bad does it get? and What can be done about it? To accomplish the objectives, the following tasks were undertaken . . .

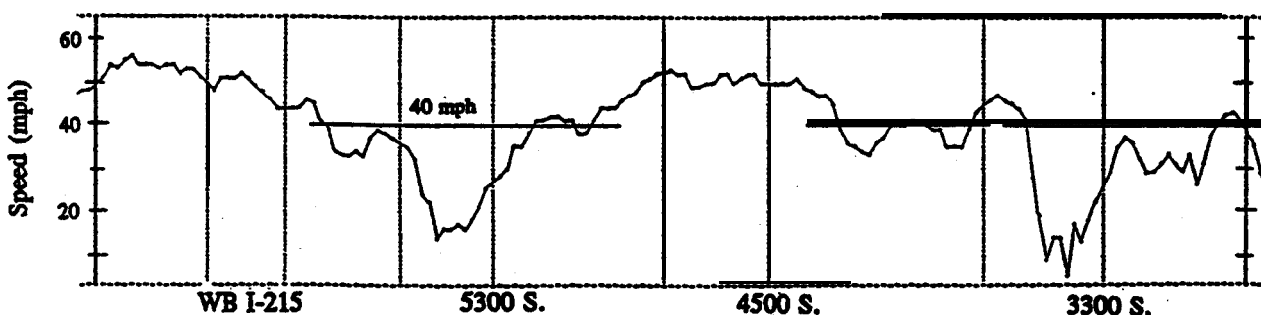
- 1: A literature search on traffic congestion, definition, quantification and measurement techniques.
- 2: A review consisting of a written survey along with ground and aerial observations to identify locations on the Interstate Highway System in Utah where recurring congestion was a problem.
- 3: Develop and test a numerical index that can indicate both the extent and duration of freeway congestion.
- 4: Recommend treatments to alleviate congestion at each of the identified sites.

Congestion (definition - causes - impacts)

Congestion is usually defined as the operational condition that exists on any roadway at any point in time when the quality of traffic flow deteriorates below an acceptable level to the user. There are two types of congestion; recurring, and non-recurring. Non-recurring congestion is incident based resulting from planned or unplanned events such as maintenance operations, traffic accidents, etc. that temporarily reduces the useable capacity of the system. Recurring congestion occurs repeatedly and is time-predicable as to onset, extent and duration. Congestion is associated with two main theories; Bottleneck and Speed Inversion. Although not mutually exclusive, congestion may result from either cause individually or from both simultaneously. Bottleneck occurs when traffic volume of arriving vehicles exceeds the capacity of the highway segment. Speed inversion results when a time lag occurs in the output volume within the roadway section and is attributable to the speed change alone. Because of these occurrences there are direct impacts on the environment , people and vehicles.

Developing the Freeway Congestion Index(FCI)

The researchers first needed to develop a definition of "congestion" that could be realistically represented by an index to identify when congestion was a problem. An acceptable definition was developed based on the extensive review of the literature followed by a detailed analysis. Freeway congestion, for this study, was finally defined as a condition when vehicle speeds drop below a threshold of 40mph. Subsequently, an index was developed that could be used to quantify the congestion based on the duration and congested lane-miles. Data for this equation was gathered by using an AMU-2000 distance measuring instrument, a laptop computer, and the Moving Vehicle Run Analysis Package(MVRAP) developed by the University of Florida. A typical speed vs. distance plot is shown below....



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Field Application & Verification of Freeway Congestion Index(FCI)

A pilot study was done on a 6-mile segment of I-15 in Salt Lake County from 6th South to 7200 South. Speed, distance and travel-time data were collected during the morning and evening peak periods for one week during August and October 1993. The data was collected using an instrumented vehicle that provided a continuous plot of vehicle speed vs. distance and at what times the onset and dissipation of congestion occurred. Traffic densities were obtained with oblique aerial photography. From the collected data an FCI value was calculated for each lane of the freeway and for each weekday in both southbound and northbound lanes. These were combined into a composite FCI for both the AM. and P.M. peak periods for each weekday.

Findings and Conclusions

The FCI is an index that can range from zero hours (no congestion) to 24 hours (total congestion) for all lanes in a particular highway segment. Therefore an index of 24 would indicate that all lanes were operating below the minimum threshold speed of 40mph for 24-hours. The following Table shows the average FCI's for a typical week in August for the North and Southbound lanes between 6th South in Salt Lake and 7200 South in Midvale. As an

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Northbound FCI	0.5	0.6	0.3	0.3	—
Southbound FCI	1.5	0.9	1.1	1.2	1.9

example, the FCI for the Southbound lanes on Monday is 1.5 indicating that the average traffic speed was below the 40mph threshold for one-hour and 30-minutes in all lanes. It can be seen that Southbound traffic for Monday and Friday exhibited the highest congestion rates. The lowest FCI's were for the Northbound Lanes on Wednesday and Thursday. Seasonal variations in traffic flows and daily variations could cause congestion levels to fluctuate. Based on the study, the following conclusions and recommendations were made:

→ A Freeway Congestion Index (FCI) has been developed which can be used to quantify both the extent and duration of freeway congestion when threshold speeds fall below 40mph.

→Speed vs. Distance measurement over time using an instrumented "average" probe vehicle traveling in a single lane can be used to quantify both extent and duration of congestion for use in calculating an FCI.

→The FCI can be used to compare changes in the congestion level on a freeway segment, or system over time. It can also be used to compare levels of congestion on different segments, subsystems, or systems.

→Recurring congestion of Utah freeways is mild compared with that in many U.S. urban areas but it is nonetheless a source of concern to the citizenry and public officials because of its impacts on travel time, fuel consumption, air quality, human stress, business costs, economic productivity, and human health.

→For the 32-sites identified as having recurring congestion, the most cost-effective short-term remedy would be the implementation of a RAMP-METERING system. These systems supply traffic in a controlled or regulated volume using traffic lights to pre-time access.

→Other recommendations to reduce traffic congestion include RIDESHARING, WORK RESCHEDULING, PARK-and-RIDE, PARATRANSIT, TRANSPORTATIONMANAGEMENT ASSOCIATION, and TRIP REDUCTION ORDINANCES .

Results or copies of this report can be obtained by contacting the UDOT Research Division @ 801-965-4196: Refer to Report #'s VT-9406 and UT-9406A. Titled: Strategies to Reduce Recurring Interstate Congestion

